Much More Than Pretty Colors
What do you get when you compile a list of the best #BluePowerade tweets and user content? This. Very. Moment.

FEELING THIRSTY?
#BLUEPOWERADE

INGREDIENTS:

WATER, SUGAR, DEXTROSE, CITRIC ACID, NATURAL AND ARTIFICIAL FLAVOR, SALT, SODIUM CITRATE, MONOPOTASSIUM PHOSPHATE, MODIFIED FOOD STARCH, GLYCEROL ESTER OF ROSIN, BLUE 1
Have you ever thought about what makes a good food coloring?
A good food coloring needs to be:

• Soluble in water
• Able to retain their color for a long time
How is that possible?
FD&C blue dye #1

Ionic compounds that dissolve in water are polar.
Food dyes absorb and transmit a certain color

How much?

Absorbance and concentration are related
Engineers use this relationship in quality control laboratories for food and pharmaceutical industries.
Today’s Activity

Lab Connection: Measuring the absorbance of solutions with various concentrations of food dye and measure the concentration of a Gatorade sample.

Engineering: To design/construct a spectrophotometer/measuring instrument/analyzers
Teacher Demonstration - Absorbance

Food dyes have molecules that absorb some wavelengths of light and let others pass through. Absorption is caused by bringing an electron in a molecule, atom, or ion to a higher energy level.
y = mx + b

b = 0 = y intercept is zero

y = abc

Absorbance \( \propto \) concentration
Absorbance = constant \( \times \) concentration
Absorbance = \( abC \)
Where \( a = \) absorptivity is constant for the substance
\( b = \) pathlength which is going to be same for the instrument (cuvette)
\( c = \) concentration
\( A = abc \)
Spectroscopy is the study of the interaction of light and matter as a function of wavelength.

Engineers and scientists use spectroscopy as a tool to analyze the interaction between light and matter.
Unknown Sample - Gatorade

Known Sample - Stock solution with blue food color
What is the unit of concentration of a solution?

Molarity (M)
Write the dilution formula

\[ M_1V_1 = M_2V_2 \]
\[ M_1 = 6 \times 10^{-6} \text{ (for all)} \]
\[ V_2 = 10 \text{ ml (for all)} \]
\[ V_1 \text{ from the data table} \]
Substitute and calculate \( M_2 \)
\[ M_1 V_1 = M_2 V_2 \]
\[ 6 \times 10^{-6} \times 2 = M_2 \times 10 \]
\[ M_2 = (6 \times 10^{-6} \times 2)/10 \]
## Data Table

\[ M_1 = 6 \times 10^{-6} \text{ (for all)} \quad V_2 = 10 \text{ ml (for all)} \]

\[ V_1 \text{ (from the data table)} \text{ Substitute and calculate } M_2 \]

| Test tube # | Volume of the stock solution (ml) \( V_1 \) | Volume of water (ml) | Concentration of diluted sample (M) 

\[ M_1 V_1 = M_2 V_2 \]

<p>| | | | |</p>
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<td>4.8 \times 10^{-6}</td>
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</table>
Construct a spectrophotometer with the given popsicle sticks.

Make a sample holder that holds the sample, the detector and light source at an appropriate distance.
Download ColorimeterX on your smartphone
Procedure to measure absorbance:

1. Take 10 ml of the blank (distilled water) and wipe the side to make it clean and dry.
2. Tap the color identifier on your smartphone and record the red value on your data sheet.
3. Repeat steps 1-3 with diluted samples # 2-5.
4. Record the data in the data table in the appropriate concentration row.
5. Take a picture of your experimental setup and include it in your lab report.
6. Measure the absorbance of the unknown sample.
# Data Table

<table>
<thead>
<tr>
<th>Test tube</th>
<th>Stock Solution (6 x 10^{-6} M)</th>
<th>H₂O (ml)</th>
<th>Concentration (M)</th>
<th>R value</th>
<th>Absorbance = -\log(I/I₀)</th>
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Plot a graph on Excel.

- Graph the data concentration (x-axis) vs. absorbance (y-axis).
- Provide an appropriate title and label x and y axes.
- Enter the values of concentration and absorbance into two columns.
- Highlight the cells and click on scatter plot.
- Right click on the graph and click on Trend Line.
- Then click on add equation and display equation. You will get an equation in $y = mx + c$ format.
- Select Linear as the Fit Equation → The best-fit linear regression line will be shown on the graph for your five data points.
Additional Pictures of Experimental Set up